foreign body can be promptly differentiated as a black speck on the red reflex from the fundus. While the eye is thus illuminated with the ophthalmoscope in one hand, and the foreign body is kept in view, with the other hand the spud is held and the foreign body readily removed. The observer can tell at once when the offending particle is gone. Since employing this method I have never used the Berger loupe.

DR. E. A. SHUMWAY, Philadelphia: This apparatus has the advantage of leaving both hands free. No assistant is then necessary. The lids can be held with one hand, while the spud is manipulated with the other, and the lighting apparatus is entirely independent of wires, so that the surgeon may walk freely about.

NAGEL'S ANOMALOSCOPE FOR TESTING COLOR-VISION.

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Just before the war I was able to get from Franz Schmidt and Haensch, of Berlin, one of Nagel's anomaloscopes for testing the color vision, and the use of this instrument during the past year has shown that it is a valuable addition to our methods for testing the color sense, especially in the determination of doubtful cases. On account of its cost and delicacy the instrument is not well adapted to the routine examination of large numbers of men at many different places, but it should be available at some central station where the reëxamination of doubtful or appealed cases can be made.

In this instrument only pure spectrum colors are used, and a record of the examination can be made in definite form which can be referred to or reproduced at any time.

The principle of the instrument depends on the fact shown by Rayleigh that, when a normal eye looks at a colored field of which one half is uniformly lighted by a pure yellow light from about the sodium line, and the other half by a mixture of red from about the lithium line and a green from about the thallium line, there will be found a certain mixture of the

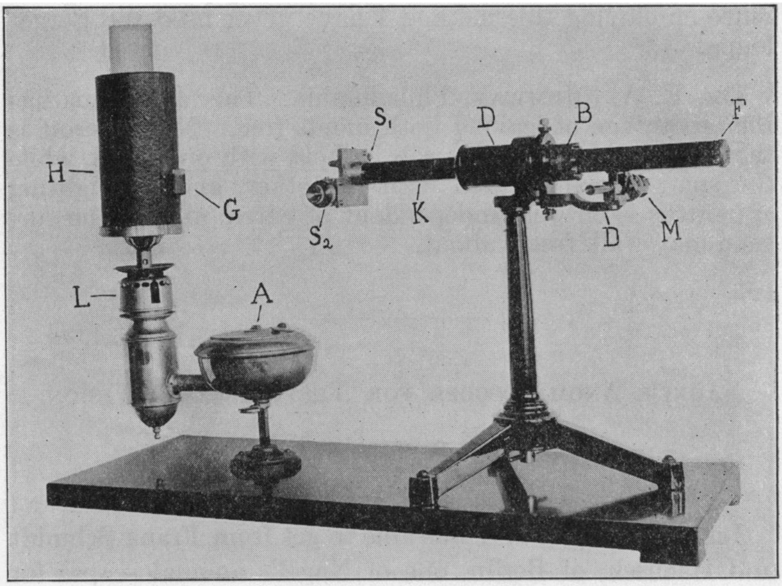

Fig. 1.—Nagel's anomaloscope for testing color vision.

K, Collimator tube; F, eye-piece tube; D, prism; M and lower D, screws to control position of eye-piece tube; B, diaphragm, to alter size of visual field; A, holder for alcohol; L, mantle lamp using alcohol vapor; H, asbestos chimney surrounding glass chimney of lamp; G, ground-glass plate, source of illumination for anomaloscope; S_1, right-hand screw (G_1 of Fig. 2), controlling width of upper slit and lower half of field as seen at the eye-piece F. This screw regulates the brightness of the pure yellow half of the field. S_2, left-hand screw (G_2 of Fig. 2), controlling the width of the two coupled slits and the upper half of the field as seen at the eye-piece. Through one slit light is transmitted through the prism D, which, when seen at the eye-piece, corresponds to the lithium red; through the other slit comes the thallium green. By moving the screw, S_2, the upper half of the field is illuminated by a proportional amount of the red-green mixture, from a red to a yellow and then to a green.

red and green which gives a yellow that cannot be distinguished from the yellow of the sodium light when the intensity of the sodium light is adjusted to a certain brightness.

Such a normal eye cannot make a match between the pure yellow and the mixture of red and green by any change in the brightness of the yellow whenever the proportion of red or green in the mixture is so great as to give the mixture a red or green color, but the eye which is defective in its color sense will be able to make such a match by changing the brightness of the yellow. The arrangement of the anomaloscope is seen

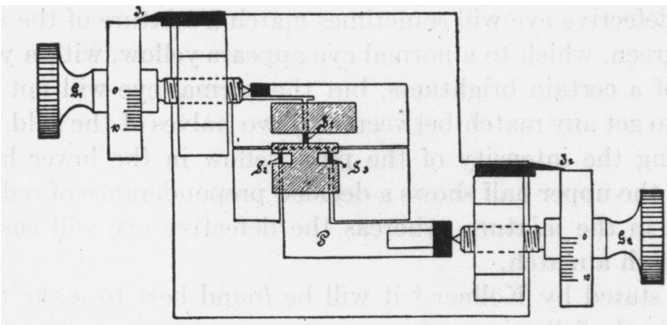

Fig. 2.—Slits on front end of Nagel's anomaloscope when looked at from the position of the lamp. (From Köllner, Die Störungen des Farbensinnes, p. 70.)

G_1 (shown at the upper left-hand side) is the right-hand screw (shown in Fig. 1 as S_1), which governs the width of the upper slit S_1 and thus changes the brightness of the yellow in the lower half of the field. G_2 is the left-hand screw (shown in Fig. 1 as S_2), which governs the width of the two coupled slits S_2 and S_3 through which the red and the green light respectively comes to make the mixture of red and green as seen in the eye-piece of the anomaloscope in the upper half of the field. These two slits are coupled together so that one can be changed only with a corresponding change in the other. The total amount of the width of both slits, the space between them, and their position relative to the prism of the instrument, remain unchanged. By means of this second screw S_2 any desired mixture of red and green can be obtained, from a pure red, through the yellow, to a pure green on the other end.

in Fig. 1. When the screw S_2 is turned to the limit in one direction, only a pure red is seen in the upper part of the field, and by turning it in the opposite direction to the limit only a pure green is seen, and between these positions any proportional mixture of red and green can be made.

The arrangement of the slits and controlling screws can be better understood from Fig. 2.

In his paper* Nagel says: "The color blind get the matching with yellow (by altering the intensity of the yellow) by every sort of proportional mixture of red and green, and even with a pure red or green, and are thus sharply differentiated from every kind of trichromats. The red-blind (protanopes) can be easily separated from the green-blind (deuteranopes) because they must give a different brightness to the yellow in order to obtain a match."

A defective eye will sometimes match a mixture of the red and green, which to a normal eye appears yellow, with a yellow of a certain brightness, but the normal eye will not be able to get any match between the two halves of the field by varying the intensity of the pure yellow in the lower half when the upper half shows a decided preponderance of red or green in the mixture, whereas the defective eye will easily find such a match.

As stated by Köllner,† it will be found best to make the tests in the following order:

1. In the upper part of the field a pure red; see if it is possible to get any match between the two halves of the field by changing the brightness of the yellow.

2. Place the screw S_1 so that the sodium yellow, lower half, corresponds to the brightness which the normal eye matches with the red-green mixture (when set at about 62, yellow, for screw S_2) in the upper half of the field (usually at about 14 on the scale of screw S_1), and see if a match can be made between the two halves by turning the screw S_2 so as to vary the red-green mixture. This can be done in most cases, but not in all.

3. Place the left screw S_2 so that it is about 15 numbers lower on its scale than the normal (about the average number for the deuteranope), and see if a match can be made by varying the intensity of the yellow with the right screw S_1.

* *Zeitschr. f. Augenheilk.*, xvii, No. 3.

† Die Störungen des Farbensinnes, Dr. Hans Köllner, p. 72.

4. Place the left screw at about 10 numbers higher than the normal (about the average for the protanope), and see if a match can be made by changing the intensity of the yellow with the right screw S_1.

THE MAY ELECTRIC OPHTHALMOSCOPE.

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The essential advantage of the ophthalmoscope, and the one in which it differs and is superior to all other luminous instruments of this sort, is the substitution of a solid rod of glass acting as a condenser at its lower part and as a reflecting prism at its upper part, with the addition of other converging surfaces sufficient to gather the rays with which the fundus is lighted up, so that there results a solid illuminated surface. This is the main improvement and it is a marked one.

In the ordinary reflecting ophthalmoscope a stationary round or a tilting oblong concave mirror is used to reflect the light from the source of illumination into the eye; good results ensue only when the source of illumination is solid; hence we use an Argand burner, or if we employ an electric lamp we must get rid of the film effect and use a spiral film with frosted globe; we all know how unsatisfactory the ophthalmoscopic examination is when an electric lamp is used with the ordinary film. An objection to all electric ophthalmoscopes which are founded upon the principle of using a mirror, whether glass or metal, to reflect the electric light contained in the stem of the instrument, such as was introduced by Dennett, is that the illuminated area of the fundus will always have the form of the lamp filament. In my device this is obviated and an even, solid collection of rays is thrown upon the background, free from shadow, reflex, or suggestion of lamp filament.